

**Ollscoil na hÉireann, Gaillimh**  
*National University of Ireland, Galway*

**Summer Examinations, 2010/2011**

Exam Code(s)	4IF
Exam(s)	4th Year Examination in BSc in IT
Module Code(s)	CT421
Module(s)	Artificial Intelligence
Repeat Paper	
External Examiner(s)	Professor M. O'Boyle
Internal Examiner(s)	Dr J. Duggan Professor G. Lyons Dr Conn Mulvihill Dr. F. S. Smith

**Instructions:** Attempt 2 questions from section A and two questions from section B

Duration	<b><u>3 hours</u></b>
No. of Pages	<u>4</u>
Department(s)	<u>Information Technology</u>

## Section A

1)

a) Write the following Prolog predicates:

i) `square(X,Y)`. where Y is the square of X, e.g.:

`:-square(5,Y).`

`Y = 25`

Explain how your predicate would respond to the following query:

`:-square(A,36).`

(7 marks)

ii) `sumlist(List,Sum)`. where Sum is the sum of the elements in the list List. e.g.:

`:-sum([1,2,3],X).`

`X = 6`

(9 marks)

b) Explain what is meant by the "Closed World Assumption" in Prolog, pay particular attention to its advantages and disadvantages.

(9 marks)

2) Write Prolog predicates to do the following:

a) `reverse(L1,L2)`. where L2 is reverse of list. e.g.:

`:-reverse([a,b,a,c],Res).`

gives the result

`Res = [c,a,b,a].`

(12 marks)

b) `subset(L1,L2)`. where list L1 is a subset of list L2, e.g.:

`:-subset([a,b],[c,b,a]).`

gives the result

yes

(Hint: use the member predicate)

(13 marks)

3)

- a) Explain what is meant by Qualitative Reasoning. What are its advantages and disadvantages.  
(4 marks)
- b) Give an example of an application where Qualitative Reasoning would be suitable. Justify your answer.  
(3 marks)
- c) Give an example of an application where Qualitative Reasoning would not be suitable. Justify your answer.  
(3 marks)
- d) Given the following constraints (which represent the motion of a ball being thrown in the air):

DERIV(  $x$  ,  $v$  )

DERIV(  $v$  ,  $a$  )

$a = g < 0$

and the quantity spaces:

$\{ -\infty, 0, \infty \}$  for  $v$

$\{ 0, \text{top} \}$  for  $x$

If the initial state is:

$QS(x, t_1) = \langle \text{top}, \text{std} \rangle$

$QS(v, t_1) = \langle 0, \text{dec} \rangle$

$QS(a, t_1) = \langle g, \text{std} \rangle$

What are the possible next states? (Show your workings)

Rule-id	$QS(v, t_i)$	$QS(v, t_{i+1})$
P1	$\langle l_i, \text{std} \rangle$	$\langle l_i, \text{std} \rangle$
P2	$\langle l_i, \text{std} \rangle$	$\langle (l_i, l_{i+1}), \text{inc} \rangle$
P3	$\langle l_i, \text{std} \rangle$	$\langle (l_{i-1}, l_i), \text{dec} \rangle$
P4	$\langle l_i, \text{inc} \rangle$	$\langle (l_i, l_{i+1}), \text{inc} \rangle$
P5	$\langle (l_i, l_{i+1}), \text{inc} \rangle$	$\langle (l_i, l_{i+1}), \text{inc} \rangle$
P6	$\langle l_i, \text{dec} \rangle$	$\langle (l_{i-1}, l_i), \text{dec} \rangle$
P7	$\langle (l_i, l_{i+1}), \text{dec} \rangle$	$\langle (l_i, l_{i+1}), \text{dec} \rangle$

(10 marks)

- e) What discrete states would the ball pass through after being thrown up into the air?  
(5 marks)

## Section B

4)

(a) In the context of genetic algorithms, explain the operation of a fitness function (7 marks)

(b) Explain the importance of mutation for genetic algorithms (7 marks)

(c) “Watson, as seen in the game Jeopardy, demonstrates one future for intelligent agents”

Discuss this statement (11 marks)

5)

(a) Explain how a simple chatbot works (7 marks)

(b) Discuss what is meant by the terms 'child state competes' and 'hierarchical Finite State Machines' (7 marks)

(c) In the context of a simple game involving 'aim', 'fire' and 'dodge' states, explain when an internal transition might be (1) dealt with immediately or (2) deferred to the beginning of the next frame (11 marks)

6)

(a) What is meant by the term 'context-free grammar'? (7 marks)

(b) What, if anything, is amiss from a procedural perspective with the following grammar fragment:

$S \rightarrow S \text{ and } S$  (7 marks)

(c) Develop a context-free grammar to generate the language that consists of strings of length  $N$  of 'a' followed by strings of length  $N$  of 'b',  $N \geq 0$ .

Examples include the empty string, ab, aabb, aaabbb (11 marks)